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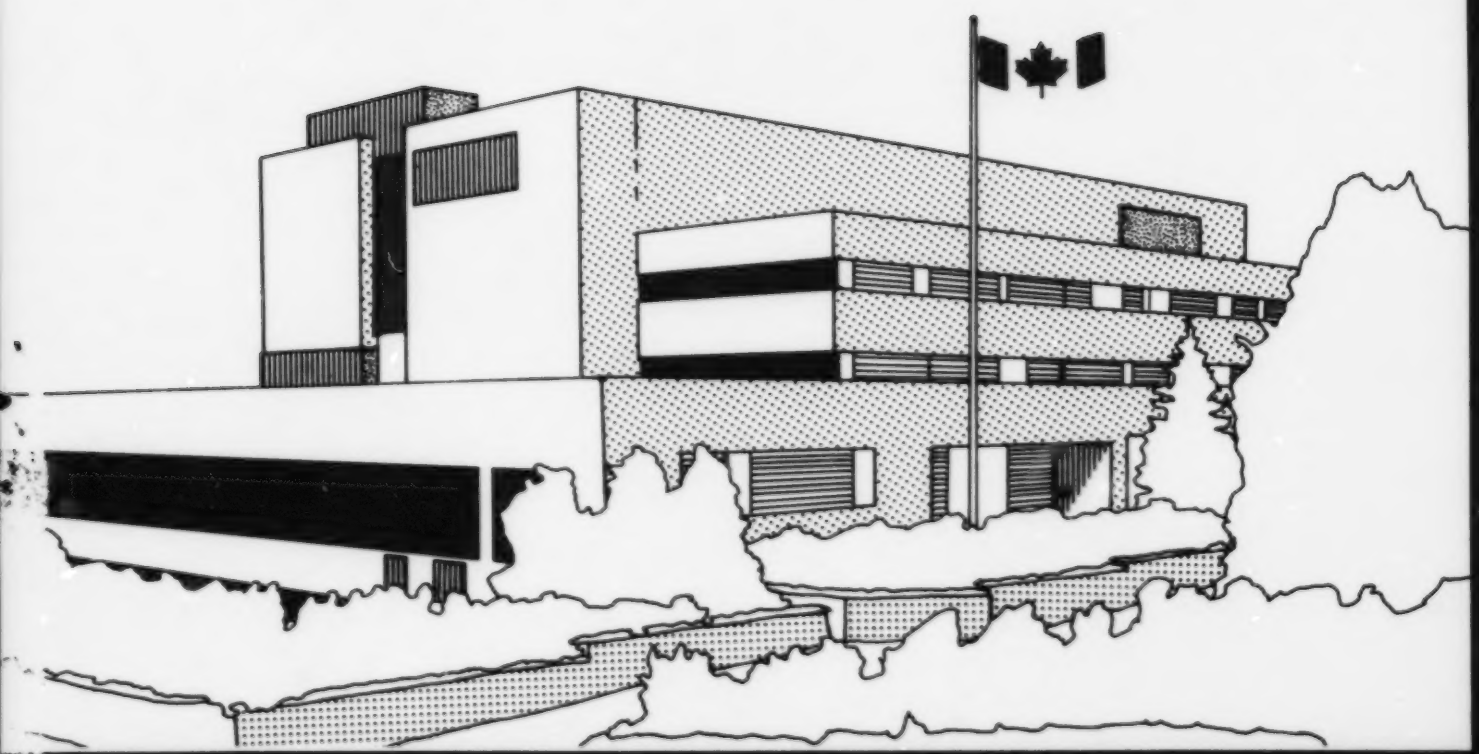
Results of forest insect and disease surveys in the EASTERN REGION of Ontario, 1988

CARRIED OUT BY THE GREAT LAKES FORESTRY CENTRE IN COOPERATION WITH THE ONTARIO MINISTRY OF NATURAL RESOURCES

A. Kelzer

Miscellaneous Report No. 89



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The Great Lakes Forestry Centre is one of six regional establishments located across Canada and operated by Forestry Canada. The overall objective of Forestry Canada is to promote the preservation, enhancement and wise use of a healthy, attractive and bountiful forest resource and terrestrial environment for the economic and social benefit of all Canadians. The Centre pursues this objective by conducting two major programs: research and technical services and forestry development. Both programs address major problems affecting forest management and the forest environment primarily in Ontario, but because of the transprovincial nature of the forest resource, many elements of our research program are of national significance.

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RESULTS OF FOREST INSECT AND DISEASE SURVEYS IN THE EASTERN REGION OF ONTARIO 1988

(FOREST DISTRICTS: NAPANEE, TWEED, CARLETON PLACE, CORNWALL AND BROCKVILLE)

A. KEIZER

FORESTRY CANADA

ONTARIO REGION

GREAT LAKES FORESTRY CENTRE

1989

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SURVEY HIGHLIGHTS

The following report describes forest damage by insects, diseases and abiotic agents in the Eastern Region of Ontario during 1988. Included are summaries of forest decline and dieback evaluations as well as special surveys, infestation forecasts and miscellaneous pests.

A major outbreak of cedar leafminer populations has occurred across the region, causing extensive damage to cedar over approximately 2.8 million ha.

Since 1981, except for the past two years, during which the area of defoliation was considerably reduced, the gypsy moth has caused considerable damage to oak and mixed hardwood forests. In 1988 the area of moderate-to-severe defoliation more than doubled, covering 28,070 ha. A total area of 13,784 ha of private and crown land was aerially sprayed by the Ontario Ministry of Natural Resources (OMNR) in the Eastern, Southwestern and Central regions.

Damage caused by the forest tent caterpillar has increased from 980 ha of moderate-to-severe defoliation in 1987 to 125,644 ha in 1988. Egg-band surveys indicate that further expansion may occur into the eastern portion of the region.

Increased populations of the eastern tent caterpillar, pine false webworm and jack pine sawfly, as well as associated damage, were evident in most districts.

A new infestation of the beech scale has been observed in the Napanee District. An associated beech bark disease from the same scale-infested area was recorded for the first time by Forest Insect and Disease Survey (FIDS) staff. Results of surveys for Scleroderris canker have once again been negative within the region.

A warm, drier-than-average season caused drought symptoms in forests covering 20,176 ha in the Napanee, Carleton Place, Brockville and Tweed districts.

Special surveys included red pine plantation evaluations, red pine cone and seed collections and various dieback and decline evaluations, as well as a new project in conjunction with the United States Forest Service. The North American Sugar Maple Decline Project consists of 24 plot sites across Ontario, three of them located in the Eastern Region. New plots have also been established in the Carleton Place District in an effort to monitor known pinewood nematode populations.

A small area of Douglas fir contained high levels of infection of Swiss needle cast in the Greenbelt Forest of the National Capital Commission, Ottawa.

As in previous years, pests in this report are categorized as follows:

Major Insects/Diseases

Capable of causing serious injury to or death of living trees or shrubs

Minor Insects/Diseases

Capable of causing sporadic or localized injury but not usually a serious threat to living trees or shrubs

Other Forest Insects/Diseases (Tables)

These tables provide information on two types of pest:

(1) those that are of minor importance and have not been shown to cause serious damage to forest trees

(2) those that are capable of causing serious damage but, because of low populations or for other reasons, did not cause serious damage in 1988.

Once again the generous assistance and cooperation of OMNR (especially Parks staff), Conservation Authorities, Parks Canada and the National Capital Commission are truly appreciated.

A. Keizer

Frontispiece

Cedar leafminer (*Argyresthia* spp.) damage (arrows) to eastern white cedar leaflets

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INSECTS

Major Insects

Pine False Webworm, **Acantholyda erythrocephala** (L.)

High population levels were encountered for the second year at two plantations in Carleton Place District. A 1-ha area of 1.8-m red pine (**Pinus resinosa** Ait.) in Fitzroy Township sustained an average of 92% defoliation over approximately 900 trees. These trees contained an average of 28 webmasses each. In a 2.0-m-high, 9-ha red pine plantation in Ramsay Township, surveys revealed an average of 21 webmasses per tree causing 66% defoliation of 51% of the trees (Table 1). In mid-June the owner sprayed this plantation with malathion, using a mist blower for better penetration of webmasses.

Elsewhere, light defoliation (<2%) was encountered on single white pine (**Pinus strobus** L.) and red pine trees found scattered through the region.

Cedar Leafminer Complex, **Argyresthia canadensis** Free., **A. thuiella** (Pack.), **Coleotechnites thujaella** (Kft.)

The last major infestation in the Eastern Region occurred from 1978 to 1980, and at its peak during 1980, 2.7 million ha of eastern white cedar (**Thuja occidentalis** L.) were severely defoliated (see Frontispiece).

In 1988 another major outbreak occurred in the region, with 2,808,070 ha of cedar moderately to severely defoliated. This area was spread over all five districts, except for approximately 42,830 ha in Augusta, Elizabethtown, Kitley and Wolford townships of Brockville District (Fig. 1), where only light (<5%) defoliation was observed.

Numerous private landowners as well as staff of the G. Howard Ferguson Forest Station sprayed with a systemic insecticide such as Cygon 2E in May and mid-August at a rate of 1.14 mL per 0.46 L of water.

Spruce Budworm, **Choristoneura fumiferana** (Clem.)

In Ontario the area of moderate-to-severe defoliation by the spruce budworm has decreased by 45% since 1986. In 1988 the area of defoliation totalled 5,224,734 ha -- a 27% decrease from the 7,189,763 ha defoliated in 1987. This defoliation occurred in the North Central and Northwestern regions. Population declines were recorded in Atikokan, Geraldton, Nipigon, Terrace Bay and Thunder Bay districts of the North Central Region and in Fort Frances, Ignace and Sioux Lookout districts of the Northwestern Region. In the latter region increases were recorded in Dryden, Kenora and Red Lake districts (Fig. 2).

Table 1. Results of surveys for the pine false webworm on red pine at four locations in the Eastern Region of Ontario during 1988 (counts based upon the examination of 150 trees at each location).

Location (Twp)	Avg ht of trees (m)	Estimated trees per ha	Estimated area (ha)	Trees affected (%)	Foliar damage (%)	Avg no. of webmasses per tree
Carleton Place District						
Fitzroy	1.8	900	1.0	100	92	28
Ramsay[a]	2.0	1,000	9.0	51	66	21
Napanee District						
Cramahe	1.4	500	2.0	17	2	3
Brockville District						
Oxford on Rideau	1.5	1,100	4.0	4	2	1

[a] sprayed by owner with malathion

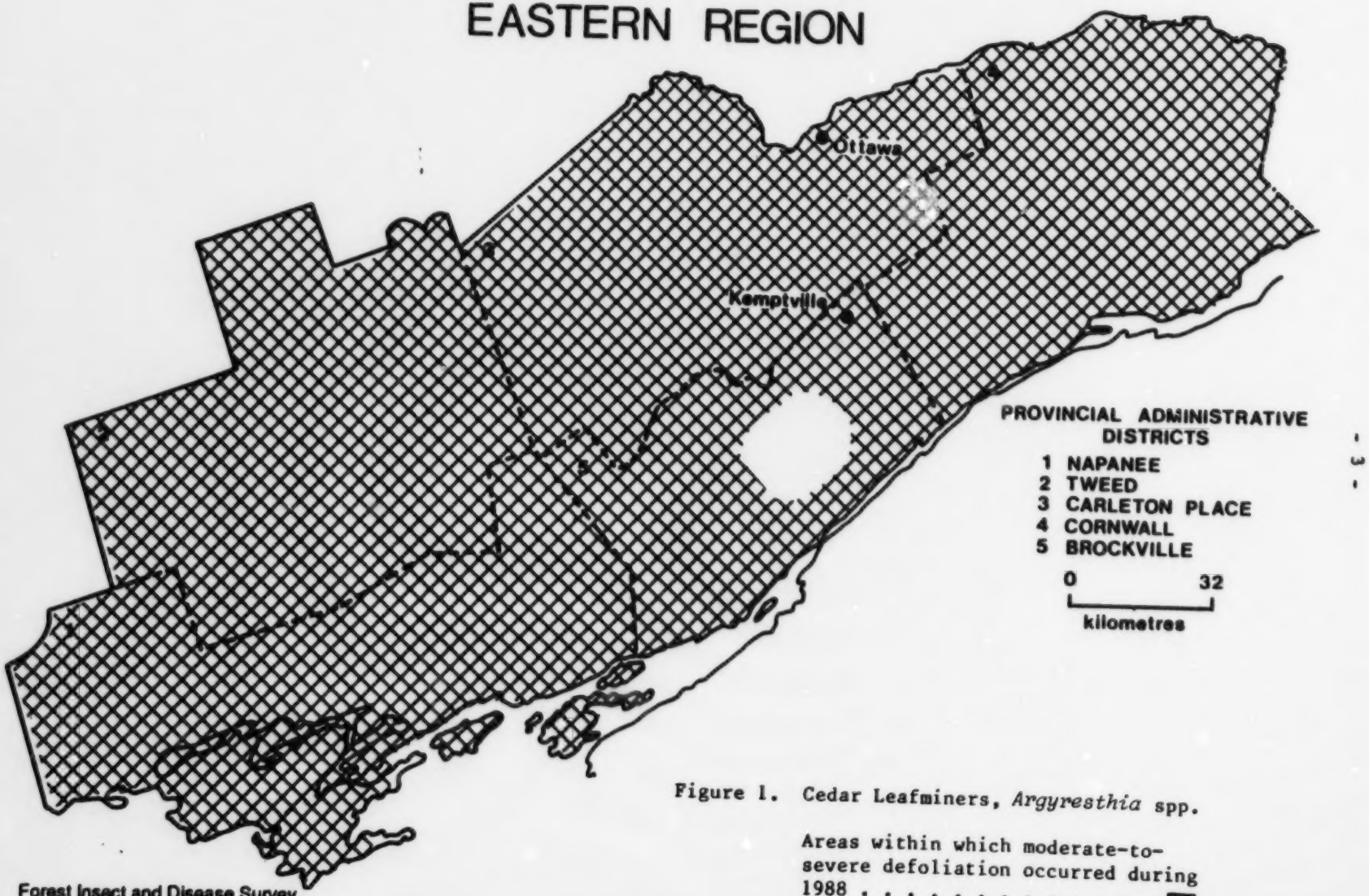
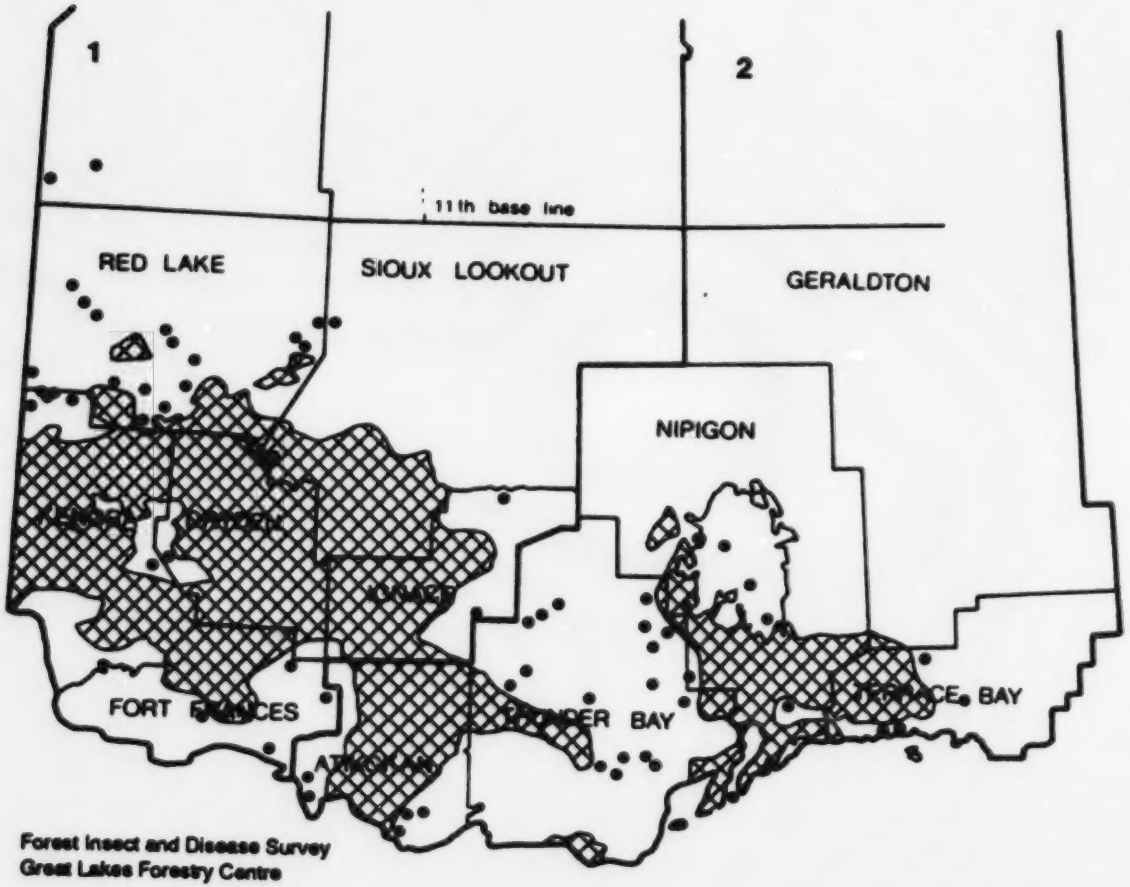


Figure 1. Cedar Leafminers, *Argyresthia* spp.

Areas within which moderate-to-severe defoliation occurred during 1988 . . . . . ⊠

NORTHWESTERN ONTARIO



PROVINCIAL ADMINISTRATIVE REGIONS :

1. NORTHWESTERN
2. NORTH CENTRAL

Figure 2. Spruce Budworm, *Choristoneura fumiferana* (Clem.)

Areas within which moderate-to-severe defoliation occurred during 1988 ... ⊠ or ■

In 1988, OMNR aerially sprayed the bacterial insecticide **Bacillus thuringiensis** (B.t.) over 14,023 ha in Nipigon and Thunder Bay districts in an effort to protect high-value forests.

Surveys in the Eastern Region revealed trace levels of this pest, as well as a slight increase in adult moth captures in light traps. Approximately 26 adults were captured between 13 June and 31 July, 17 of them between 19 and 21 July in Oxford on Rideau Township, Carleton Place District. Egg-mass surveys in Denbigh Township of Tweed District and Lavant Township of Carleton Place District indicate that population levels will remain low in these areas in 1989.

Beech Scale, **Cryptococcus fagisuga** Linding.

Several areas containing beech (**Fagus grandifolia** Ehrh.) were surveyed throughout the region, with emphasis on stands located near the St. Lawrence River and neighboring New York state infestations.

Reinfestation and slight expansion have occurred in Brockville District at the Gananoque golf course, where approximately 20 beech trees scattered through a 3-ha area contain large populations of the scale. This is a possible expansion from the two heavily infested trees present in the same area in 1987.

Another new infestation was discovered in Presqu'ile Provincial Park, Napanee District, where 18% of the beech scattered over approximately 20 ha of lakefront property contained large insect populations (photo page).

A tree infected with an associated beech bark disease was sampled from this same location. Feeding by the scale insect may possibly predispose the bark to subsequent damaging agents such as beech bark disease, which is documented in the disease section of this report (see photo page).

Birch Leafminer, **Fenusa pusilla** (Lep.)

Ornamental and roadside birch (**Betula** spp.) trees sustaining 100% foliar browning were again evident through most urban areas. The largest forested area to contain severe defoliation was detected from the air near Bellamy Lake in Kitley Township, Brockville District. Here, approximately 5 ha of white birch (**B. papyrifera** Marsh.) displayed severe foliar browning.

Fall Webworm, **Hyphantria cunea** (Drury)

For the second consecutive season since a general outbreak began in 1980, this insect has decreased in numbers. Single roadside and fencerow hardwoods containing webs were less evident or absent from areas in which high numbers were encountered last year.

Infested trees containing 3 to 18 webs and experiencing 10 to 90% defoliation were observed along Leeds and Grenville County Road 7 in Kitley Township, along Highway 16 in Edwardsburgh Township, Brockville District, and along Highway 30 in Brighton Township, Napanee District.

Gypsy Moth, **Lymantria dispar** (L.)

In 1988 the area of moderate-to-severe defoliation increased approximately 2.4 times over the 11,564 ha mapped from the air in 1987, to a total of 28,070 ha (Fig. 3). This increase occurred in Tweed, Napanee and Carleton Place districts.

The total area defoliated in Tweed District increased from 3,329 ha to 16,089 ha (Tables 2 and 3). The largest single area of defoliation in the region (10,558 ha) was in Kaladar, Hungerford and Kennebec townships (Fig. 4), primarily along Highway 7. This area also exhibited defoliation by the forest tent caterpillar (**Malacosoma disstria** Hbn.).

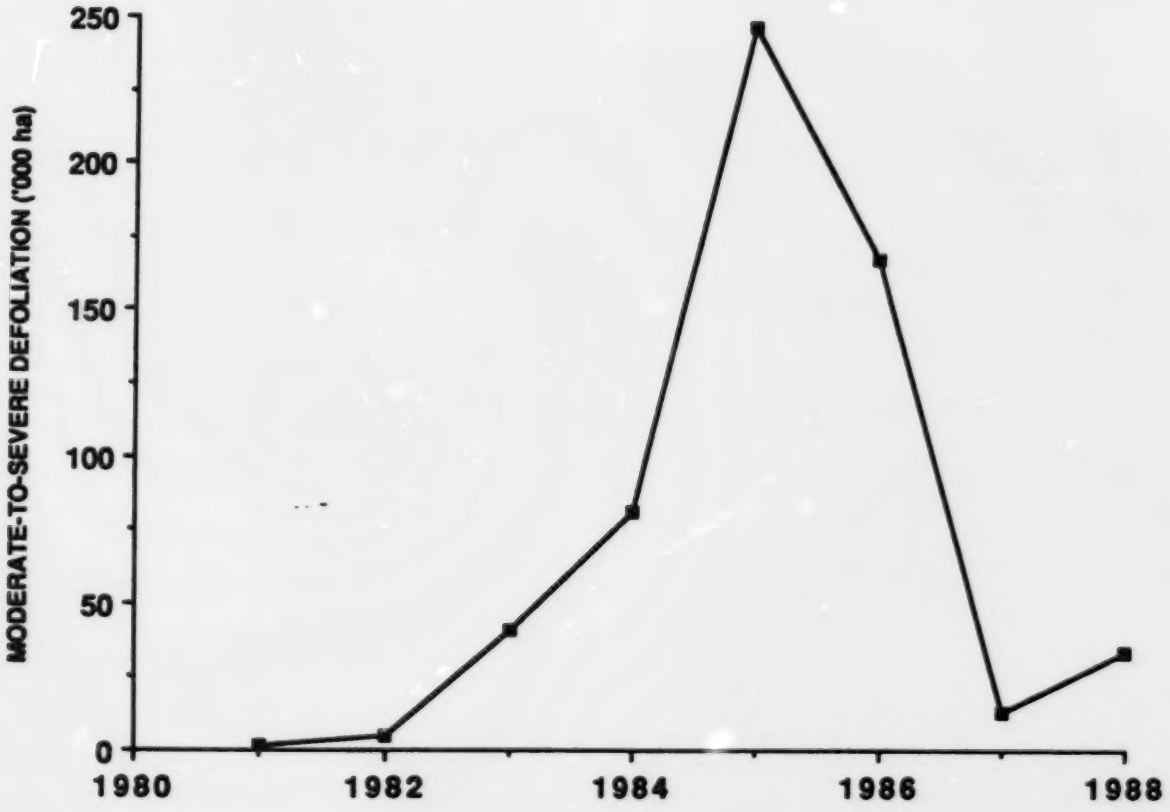


Figure 3. Yearly comparison of moderate-to-severe defoliation ('000 ha) caused by the gypsy moth (*Lymantria dispar* L.) in the Eastern Region from 1981 to 1988.

Table 2. Gross area (ha) of moderate-to-severe defoliation by the gypsy moth in the Eastern Region of Ontario in 1987 and 1988 (by district).

District	1987	1988	Change	
			%	Area (ha)
Tweed	3,329	16,089	+483	+12,760
Napanee	4,781	6,198	+130	+1,417
Carleton Place	1,355	3,918	+289	+2,563
Brockville	2,099	1,865	-11	-234
Total	11,564	28,070	+243	+16,506

Table 3. Gross area (ha) of moderate-to-severe defoliation by the gypsy moth in 1987 and 1988 (by county) in the Eastern Region of Ontario.

County	Area (ha)	
	1987	1988
Lennox and Addington	407	10,007
Northumberland	2,131	4,806[a]
Hastings	4,511	5,613[b]
Lanark	1,355	3,918
Leeds and Grenville	2,099	1,865
Frontenac	1,775	1,861
Prince Edward	0	0
Ottawa-Carleton	0	0

[a] not including 2,965 ha in Lindsay District of the Central Region

[b] not including 12 ha in Bancroft District of the Algonquin Region

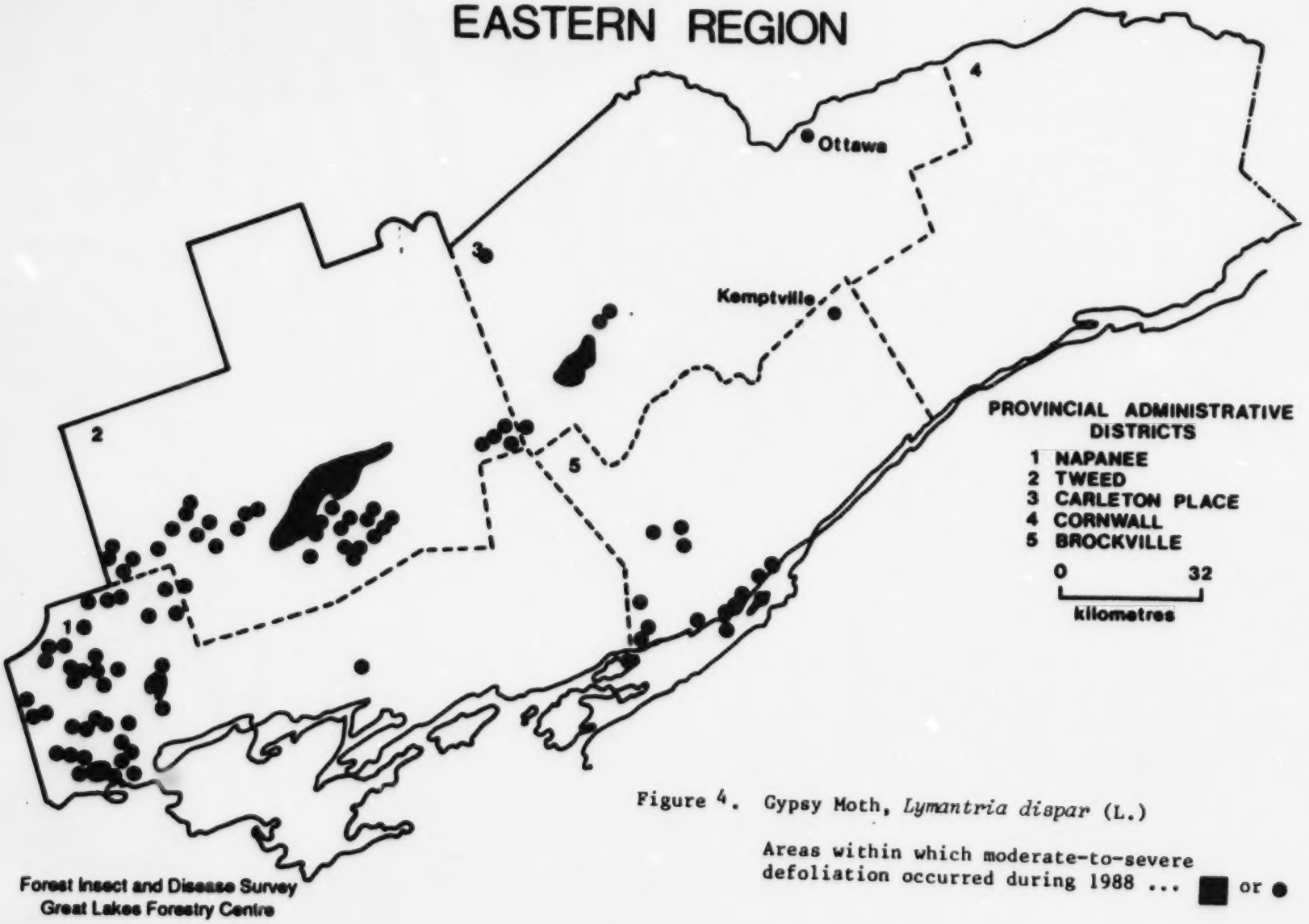


Figure 4. Gypsy Moth, *Lymantria dispar* (L.)

Areas within which moderate-to-severe defoliation occurred during 1988 ... ■ or ●

Other scattered pockets of moderate-to-severe defoliation by gypsy moth were located in Oso, Sheffield, Elzevir, Madoc and Marmora townships.

In Napanee District, the area of defoliation increased from 4,781 ha in 1987 to 6,198 ha in 1988. Defoliated trees were primarily on hilltops in Rawdon, Seymour, Percy, Cramahe, Brighton, Murray and Sidney townships, and the areas defoliated ranged in size from 12 to 538 ha.

As previously mentioned, some areas infested by the gypsy moth had already sustained foliar damage by the earlier-feeding forest tent caterpillar. This overlapping also occurred south of Bennet Lake in Bathurst Township, Carleton Place District, where 3,567 ha of oak (**Quercus** spp.) and maple (**Acer** spp.) were infested by both major defoliators. Two smaller areas totaling 271 ha were defoliated primarily by the gypsy moth in adjacent Drummond Township. A smaller hillside area north of Joe's Lake in Pakenham Township totaling 42 ha was also detected from the air, bringing the total defoliation in Carleton Place District to 3,918 ha.

In Brockville District, the area of moderate-to-severe defoliation decreased from 2,099 ha in 1987 to 1,865 ha in 1988. This decline occurred primarily in the Charleston Lake area, where only 246 ha were affected in 1988 near the town of Lyndhurst. New infestations occurred along the St. Lawrence River in Front of Escott and Front of Yonge townships, and areas near Gananoque in Front of Leeds and Lansdowne Township were reinfested.

On Howe Island in the St. Lawrence River, 50 ha of defoliation were mapped for the third consecutive year, and stands in six hilltop areas totaling 162 ha on Grenadier Island sustained defoliation for the second year. A new infestation was recorded over 381 ha of Hill Island between Howe and Grenadier islands.

A total area of 13,784 ha (9,256 ha of private land and 4,528 ha of crown land) was aerially sprayed last spring with single or multiple applications of the bacterial insecticide B.t. These areas were located in Brockville, Carleton Place, Napanee and Tweed districts of the Eastern Region; in Lindsay District of the Central Region; and in Simcoe District of the Southwestern Region.

Quantitative relationships between larval densities, defoliation estimates, egg-mass densities and adult pheromone trapping were again assessed at 14 provincial parks in the region with the generous assistance of parks staff from OMNR (Table 4). The highest larval counts (1,195) in burlap traps were again made in Sharbot Lake Provincial Park, Tweed District. At Bon Echo Provincial Park, also in Tweed District, the total number of larvae captured decreased from 23 in 1987 to zero in 1988.

The second highest larval count (910) was made in Napanee District at Frontenac Provincial Park. Four other locations in the Napanee District had lower counts than in 1987 (Table 4).

Table 4. A summary of the results of gypsy moth burlap and pheromone trapping and defoliation estimates in 14 parks in the Eastern Region of Ontario during 1988.

Location (Provincial Park)	Burlap traps (10 per location) Total no. larvae		Pheromone traps (2 per location)[a] No. of male moths captured		Average defoliation estimate	
	1987	1988	1987	1988	Host(s)	%
Brockville District						
Charleston Lk	248	298	37	24	rO	4
Carleton Place District						
Fitzroy	-[b]	584	37	28	rO	5
Murphy's Point	2	0	40	20	rO, wO	5
Rideau River	0	0	15[c]	36	rO, sM	2
Silver Lk	-[b]	227	44	19	rO	5
Cornwall District						
Carillon	3	0	13	33	rO	2
Jessup's Falls Cons. Area	50	61	13	29	rO	8
Napanee District						
Ferris	233	-[b]	13[c]	24	rO	2
Frontenac	185	910	16	25	rO, sM	10
Lake-on-the-mountain	397	0	-[d]	18	sM	2
Presqu'ile	116	13	44	22[c]	rO	0
Sandbanks	211	31	28	34	rO, wO	2
Tweed District						
Bon Echo	23	0	14[c]	10[c]	rO	2
Sharbot Lk	2,135	1,195	28	21	rO	10

[a] USDA Deltoid stick type
[b] data unavailable
[c] 1 trap missing
[d] 2 traps missing

Jessup's Falls Conservation Area in Cornwall District, Fitzroy Provincial Park in Carleton Place District and Charleston Lake Provincial Park in Brockville District also registered an increase in trapped larvae.

The average number of adults captured from two pheromone traps deployed at each of the 14 provincial parks was 13.2 in 1988 and 16.2 in 1987. These traps are used primarily to establish the presence and/or flights of adult male moths and are placed in each park at the entrance and at the most active interior campground or day-use area.

Egg-mass density surveys performed each fall to enable population predictions to be made for the upcoming season are not complete at this time. Other surveys completed at 14 locations through the region indicate that the highest densities of gypsy moth may be found in the Kaladar area of Tweed District and the Frontenac Provincial Park area of Napanee District (Table 4).

Eastern Tent Caterpillar, **Malacosoma americanum** F.

Increased populations were evident throughout the region again this year. Apple (**Malus** spp.) and cherry (**Prunus** spp.) trees were commonly observed supporting as many as 25 individual tents and sustaining as much as 100% defoliation. The highest concentrations of larval webbings were encountered in Tweed District: along Hastings County Road 2 in Kaladar Township; along Highway 41 north of Bishops Corners in Anglesea Township; along both sides of Highway 62 in Tudor Township; and north of Rimington on Hastings County Road 12, Madoc Township. Through the rural areas of Stirling in Napanee District host trees averaged 80% defoliation.

Forest Tent Caterpillar, **Malacosoma disstria** Hbn.

A major expansion of the area affected by this pest occurred for the fourth consecutive year in southern Ontario. A total area of 1,312,195 ha of moderate-to-severe defoliation was aerially mapped and ground surveyed during 1988.

In the Eastern Region, where 980 ha were defoliated in 1987, the area defoliated increased to 125,644 ha in 1988. The largest area of moderate-to-severe defoliation encompassed 121,174 ha of primarily mixed hardwoods in Tweed District (Fig. 5). This is part of a major infestation that continues west into Bancroft, Lindsay, Minden, Bracebridge and Parry Sound districts. This major infestation in southern Ontario began during 1985 with approximately 1,006 ha of severely defoliated forests located primarily in Parry Sound District. This area increased to 11,160 ha in 1986 and during 1987 increased southward over 473,964 ha of forest located through Parry Sound, Bracebridge, Minden, Bancroft and Pembroke districts, with scattered pockets in Huronia, Lindsay, Tweed and Carleton Place districts. By 1988 it had increased almost three times to 1,312,195 ha of moderate-to-severe defoliation (see Fig. 6), and now includes areas in Owen Sound, Algonquin Park and Cornwall districts.

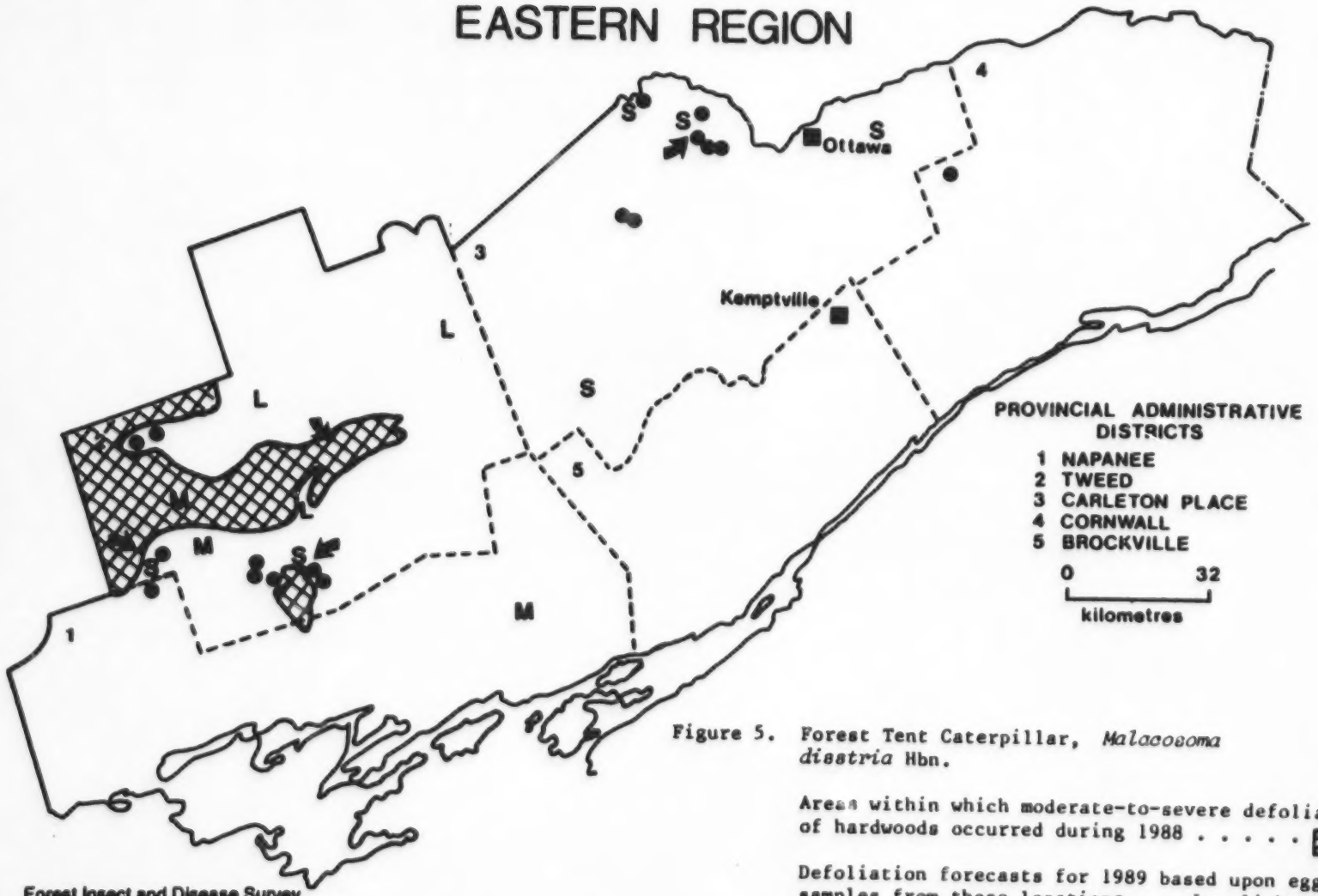


Figure 5. Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

Areas within which moderate-to-severe defoliation of hardwoods occurred during 1988 . . . . . ⊠ ●

Defoliation forecasts for 1989 based upon egg-band samples from these locations .... L - light
M - moderate
S - severe

Areas sampled for pupal mortality ..... ➘

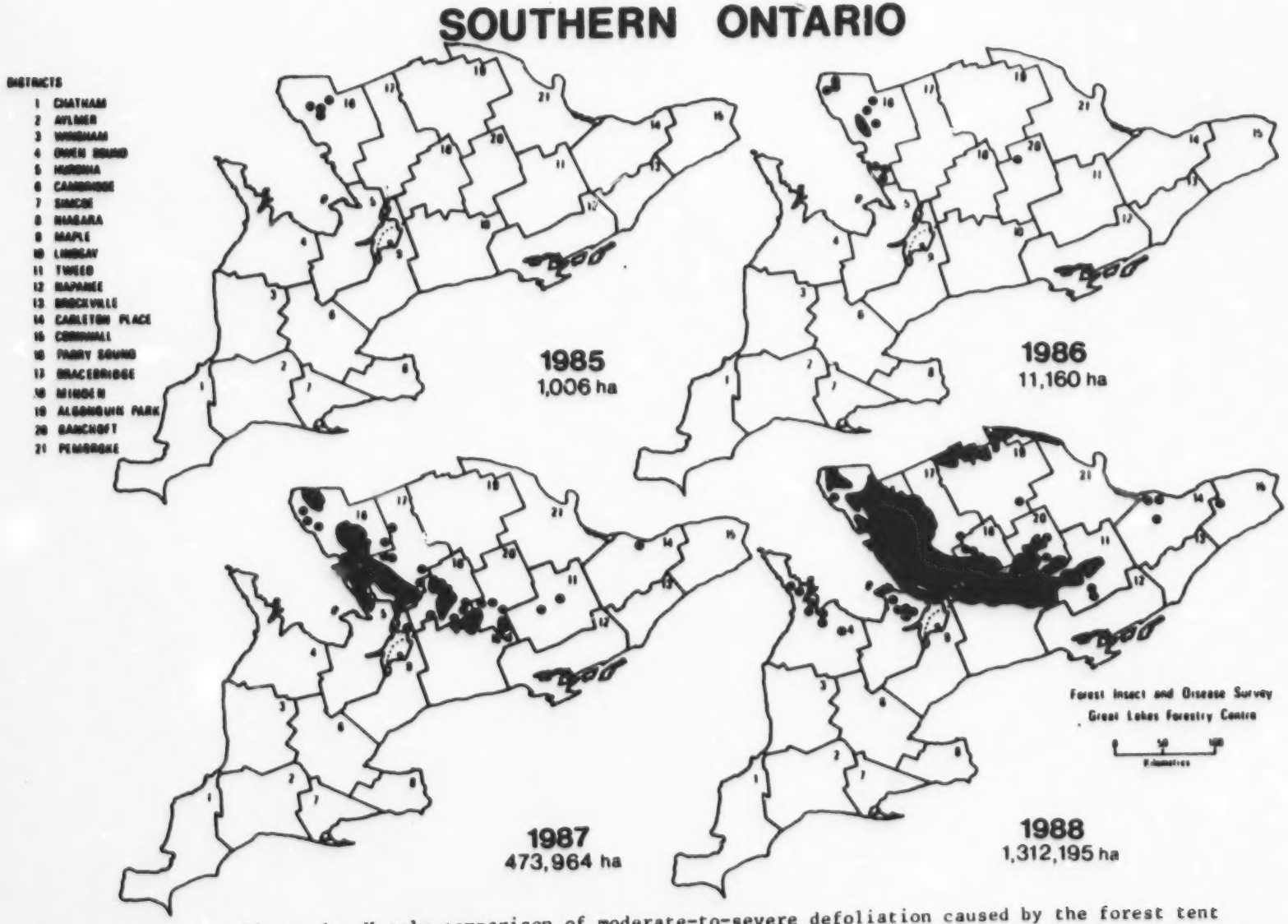


Figure 6. Yearly comparison of moderate-to-severe defoliation caused by the forest tent caterpillar (*Malacosoma disstria* Hbn.) in southern Ontario from 1985 to 1988 ..... ■ or •

Additional pockets in Tweed District totaled 4,401 ha and were located in Hungerford, Marmora and Tudor townships.

A portion of the large pocket of defoliation located in Hungerford Township extended into Tyendinaga Township, Napanee District, over 190 ha of sugar maple (**Acer saccharum** Marsh.), oak and aspen (**Populus** spp.)

In Carleton Place District six pockets of infestation totaling 3,835 ha were recorded in Ramsay, Fitzroy, Torbolton, March and Bathurst townships.

A single pocket of infestation in Cornwall District was recorded over 445 ha of primarily trembling aspen (**Populus tremuloides** Michx.) located in Russell Township.

As Table 5 indicates, on the basis of egg-band surveys made in September (Fig. 5), a reinfestation of the above areas and possibly an eastward extension may occur in 1989.

Table 5. Forest tent caterpillar egg-band samples collected from sugar maple and trembling aspen in three districts of the Eastern Region of Ontario during 1988 and infestation level forecasts for 1989.

Location (Twp)	Host	Avg DBH of tree(s) (cm)	No. of trees sampled	Avg no. of egg bands per tree	Infestation forecast for 1989
Carleton Place District					
Gloucester	tA	16	1	44	severe
Torbolton	tA	19	1	24	severe
Fitzroy	tA	18	1	33	severe
Bathurst	sM	12	1	61	severe
Tweed District					
Palmerston	sM	18	1	2	light
Anglesea	sM	20	1	4	light
Kennebec	sM	19	1	59	severe
Kaladar	sM	16	2	3	light
Hungerford	sM	24	1	79	severe
Madoc	sM	17	1	8	moderate
Marmora	sM	16	1	19	severe
Madoc	sM	10	3	12	severe
Napanee District					
Loughborough	sM	8	3	2	moderate

Various degrees of natural parasitism are common in three of the four stages in the life cycle of this insect. Incidence of egg and larval parasitism is generally lower than that of pupal parasitism because of rapid fluctuations in larval parasitism and natural protection of the eggs by a foamy "spumuline" covering provided by the adult moth at the time of deposit. The higher incidence of pupal parasitism is often attributed to a large dipteran fly, **Sarcophaga aldrichi** Park. (see photo page). A general increase in pupal parasitism and resulting mortality is commonly associated with the progressive age of an outbreak, particularly when **Sarcophaga aldrichi** is involved.

Pupal mortality can also occur as a result of a variety of diseases, and in the past has been associated with the rapid decline of some tent caterpillar populations. Disease organisms such as the nuclear polyhedrosis virus attack all stages of the insect and transmission can occur from adult to adult or as a result of contact by carriers such as the parasitic Sarcophagan fly.

Four randomly selected locations with known high caterpillar populations were sampled for pupal mortality (Fig. 5). From each site, 100 cocoons were randomly selected for examination. Dissection of each cocoon revealed successful moth emergence, dead pupae with evidence of parasites or disease, or pupae killed by an unidentified causal agent. The results in Table 6 indicate a 22 to 38% mortality range.

Table 6. Forest tent caterpillar pupal mortality counts from two districts in the Eastern Region of Ontario (based upon the examination of 100 cocoons per location).

Location (Twp)	Pupal mortality		Survival
	Parasitized (%)	Diseased or unknown (%)	(as moth emergence) (%)
Tweed District			
Marmora	13	14	73
Kaladar	8	18	74
Hungerford	15	23	62
Carleton Place District			
West Carleton	5	33	62

Balsam Fir Sawfly, **Neodiprion abietis** complex

Reduced levels of foliar damage were apparent throughout the region in 1988. Occasional balsam fir (**Abies balsamea** [L.] Mill.) trees averaged 20% upper crown defoliation along Ottawa-Carleton Regional Road 22 in Carleton Place District and along Highway 16 in Oxford on Rideau Township, Brockville District. Similar damage occurred to 20% of 15 4-m trees south of Bon Echo Provincial Park along Highway 41 in Tweed District.

Redheaded Pine Sawfly, **Neodiprion lecontei** (Fitch)

Light damage was encountered through most areas surveyed during 1988. Single colonies were observed on 2% of 2.5-m red pine trees covering 7 ha in Elzevir Township, Tweed District. A 3.0-ha plantation of 0.7-m red pine in Ramsay Township, Carleton Place District also contained single colonies on 13% of the trees. Four additional red pine plantations were surveyed in Tweed, Napanee, Brockville and Carleton Place districts, but the insect was not found.

OMNR staff in Tweed District reported a single plantation within the district with high levels of defoliation. Damage estimates and control measures will be carried out early in the spring of 1989.

Jack Pine Sawfly, **Neodiprion pratti paradoxicus** Ross

Heavy infestations have dotted this region since 1982. This year severe defoliation was observed once again on open-grown, ornamental and fringe jack pine (**Pinus banksianae** Lamb.) and Scots pine (**P. sylvestris** L.) trees. The most extensive damage occurred in two jack pine plantations in Hungerford Township, along Hastings County Road 13 near Marlbank in Tweed District, and in Ernestown Township near Highway 401 and Lennox & Addington County Road 6 of Napanee District, where larval feeding resulted in 90% defoliation of previous and new foliage at both locations. Another plantation in Augusta Township, Brockville District sustained 78% foliar damage over 10 ha of 2.1-m jack pine. Other plantations surveyed received an average 10 to 56% defoliation (Table 7).

Bruce Spanworm, **Operophtera bruceata** Hlst.

This hardwood defoliator persisted at low levels near Clayton Lake in Ramsay Township, Tweed District. Approximately 5 ha of primarily roadside sugar maple and basswood (**Tilia americana** L.) regeneration displayed a "shot-hole" appearance over 10% of the foliage. Similar feeding damage was observed on ornamental and roadside trees in the cities of Kingston in Napanee District and Brockville in Brockville District.

Table 7. Summary of jack pine sawfly evaluations in six plantations in the Eastern Region of Ontario in 1988 (evaluations based upon the examination of 150 trees).

Location (Twp)	Host	Avg ht of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Trees affected (%)	Avg defoliation per affected tree (%)
Brockville District						
Augusta	jP	2.1	1,600	10	100	78
Oxford on Rideau	jP	2.0	1,000	12	21	10
Carleton Place District						
Dalhousie	jP	2.0	1,000	1	63	56
Napanee District						
Ernestown	jP	2.0	800	3	80	90
Tweed District						
Hungerford	jP	2.8	1,200	18	97	90
Madoc	jP	3.0	50	4	60	42

Minor Insects

Maple Trumpet Skeletonizer, **Epinotia aceriella** (Clem.)

Throughout the region variable defoliation levels were observed on single roadside and ornamental maple trees, and low population levels persisted in Napanee District. There were two areas of significant damage in Napanee District: in Presqu'ile Provincial Park, where 60% of the maple trees covering approximately 10 ha suffered 20% severe foliar browning, and near Sandbanks Provincial Park, where a 10-ha sugar bush on Prince Edward County Road 12 displayed 50% foliar browning of lower crowns and regeneration.

Maple Leafcutter, **Paraclemensia acerifoliella** (Fitch)

A reduction in population levels occurred over the region during 1988. In a 4-ha sugar bush in Lanark Township, Carleton Place District and a 20-ha sugar bush in Oxford on Rideau Township, Brockville District, which were both severely infested in 1987, only minor damage occurred in 1988, with 10% defoliation of lower crowns and regeneration. Presqu'ile Provincial Park and Sandbanks Provincial Park in Napanee District sustained similar damage (see photo page).

Table 8. Other forest insects.

Insect	Host(s)	Remarks
Altica sp. A flea beetle	bW	skeletonizing to 60% of foliage around Lake-on-the-Mountain in Marysburgh Twp, Napanee District
Archips cerasivorana (Fitch) Uglynest caterpillar	pCh	single webs observed on roadside hosts of all sizes along Conc. VI in Madoc Twp, Tweed District
Cameraria hamadryadella (Clem.) Solitary oak leafminer	wO,rO	commonly affecting 10 to 60% of foliage on single trees scattered through Jessup's Falls Conservation Area, Cornwall District
Caulocampus acericaulis (MacG.) Maple petiole borer	maple	Premature leaf drop was evident throughout the region. Higher defoliation levels (10-30%) were observed along

(cont'd)

Table 8. Other forest insects (cont'd).

Insect	Host(s)	Remarks
Caulocampus acericaulis (MacG.) (concl.)	maple	Conc. XII, Ramsay Twp, Silver Lake Prov. Pk and Murphy's Point Prov. Pk in Carleton Place District; Sharbot Lake Prov. Pk and Bon Echo Prov. Pk in Tweed District; and in the urban areas of Brockville, Brighton and Campbellford (see photo page).
Chionaspis pinifoliae (Fitch) Pine needle scale	mugho pine	Six trees in the town of Kemptville, Brockville District, sustained 40% foliar damage.
Coleophora comptoniella (McD.) Lesser birch casebearer	wB	Twenty percent defoliation of single trees was evident in Murphy's Point Prov. Pk, Carleton Place District, and South Nation Prov. Pk, Cornwall District.
Coleophora limosipennella (Dup.) Elm casebearer	wE	Foliar browning on 20 to 100% of single trees was observed throughout the region, with the highest densities of affected trees along the St. Lawrence Parkway in Front of Yonge Twp, Brockville District.
Coleophora ostrayae Clem. Ironwood casebearer	bHi	Four 2-m trees contained casebearers on 80% of their foliage in Murphy's Point Prov. Pk, Carleton Place District.
Endothenia albolineana (Kft.) Spruce needleminer	wS	Approximately, 50 10-m hedgerow trees displayed 45% foliar browning in Presqu'ile Prov. Pk, Napanee District.
Exoteleia dodecella (L.) Pine bud moth	scP	The lower 25% of nine 5-m trees was affected along Hwy 16 in Edwardsburgh Twp, Brockville District.

(cont'd)

Table 8. Other forest insects (cont'd)

Insect	Host(s)	Remarks
Fenusa ulmi Sund. Elm leafminer	wE	This pest was frequently observed causing 100% foliar browning of single trees in Presqu'ile, Frontenac and Sandbanks Prov. Pks, Napanee District and along Hwy 16 in South Gower and Edwardsburg twps, Brockville District
Gracillariidae Leafminers	sW	foliar browning over 90-100% of single trees scattered through the region; particularly evident along Hwy 401 in Edwardsburg Twp, Brockville District, Carillon Prov. Pk, Cornwall District and along Hwy 43 near the town of Perth, Carleton Place District
Gonioctena americana (Schaeff.) American aspen beetle	tA	This leaf beetle caused 25 to 60% foliar browning of groups of host trees scattered along Hwy 401 in Front of Leeds and Lansdowne Twp, Oxford on Rideau Twp and Hill Island, all in Brockville District. Single trees with various levels of defoliation were obvious throughout the region.
Leucoma salicis (L.) Satin moth	sPo	Twenty 7-m trees sustained 30% defoliation at Wymens Road and Hwy 401 in Tyendinaga Twp, Napanee District.
Messa nana (Klug.) Early birch leaf edgeminer	slender birch, yB, brown chinapaper birch	This leafminer affected 20-60% of single ornamental trees at the Agriculture Canada Arboretum in Ottawa.
Phyllonorycter spp. A leafminer	Al	Serious foliar browning occurred to approximately 1 km of roadside bushes along Davidson Road in Gloucester Twp, Carleton Place District.

(cont'd)

Table 8. Other forest insects (cont'd)

Insect	Host(s)	Remarks
Periclista spp. A sawfly	rO	Single trees containing 20 to 35% defoliation were observed in Silver Lake Prov. Pk, Carleton Place District and Sharbot Lake Prov. Pk, Tweed District.
Profenusa thomsoni (Konow) Ambermarked birch leafminer	wB	Six ornamental trees at the Agricultural College in Kemptville sustained 60 to 80% defoliation.
Psilocorsis quercicella Clem. Oak leaftier	wO	Single trees with 30 to 70% foliar damage were commonly observed through the region. Groups of 2 to 5 trees displayed up to 70% foliar browning along Leeds and Grenville County Road 22, Brockville District.
Scolioneura betuleti Klug. Birch edgeminer	Szechuan wB	A single ornamental tree exhibited 60% foliar browning at the Agriculture Canada Arboretum in Ottawa; this represents a new extension of the range of this insect in Ontario.
Sparganothis niveana (Wlsm.) A leafroller	sM	Trace levels were commonly found throughout the region; in Silver Lake Prov. Pk 2-5% of leaves on six trees were affected.
Tetralopha asperatella (Clem.) Maple webworm	sM	A forest tent caterpillar-infested woodlot in Madoc Twp, Tweed District also contained high population levels of this pest over 60% of a 15-ha area.

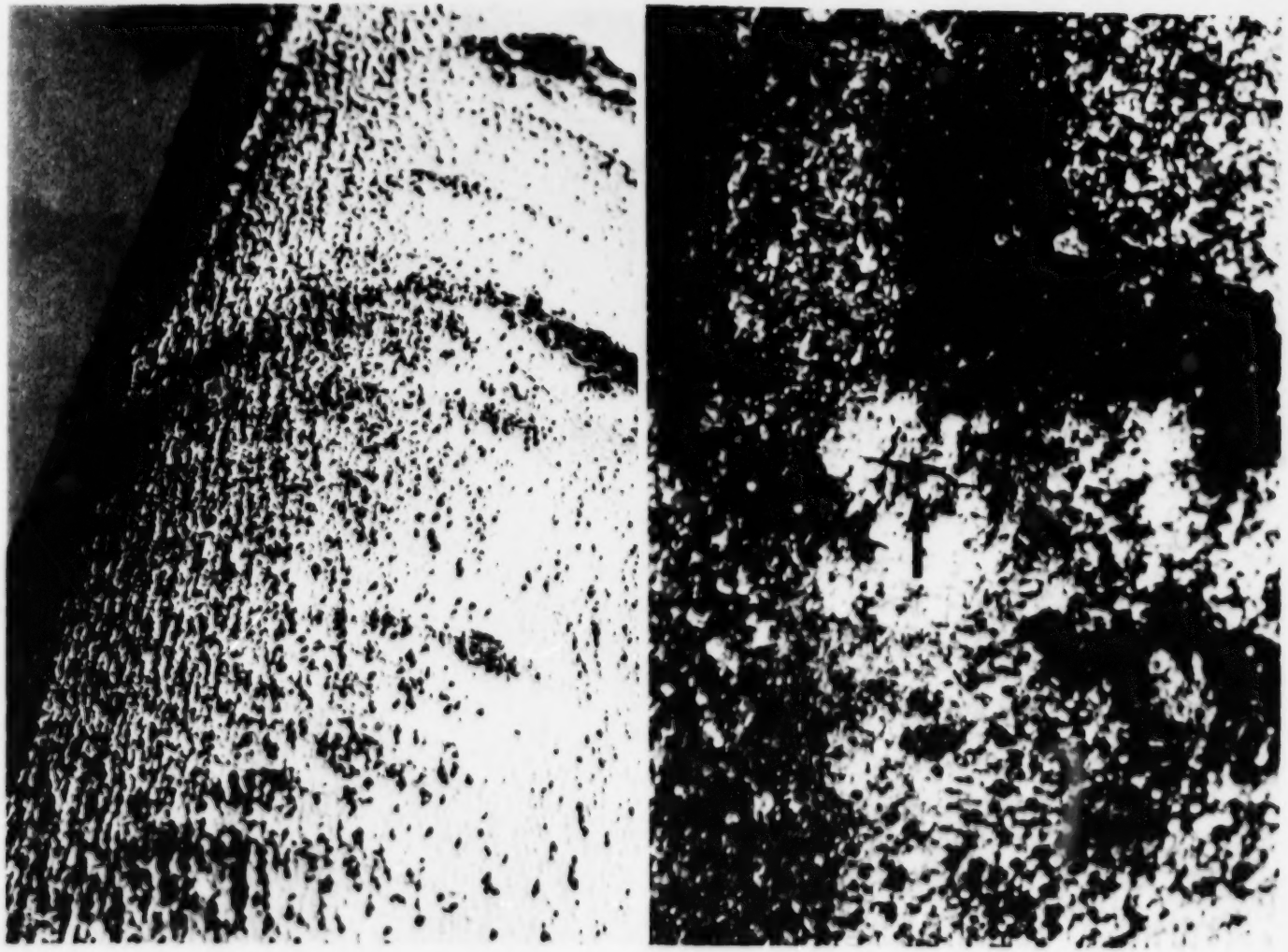
(cont'd)

Table 8. Other forest insects (concl.)

Insect	Host(s)	Remarks
Tingidae Lacewings	wE	Lacewings affected all host regeneration along a 2-km section of Prescott and Russell County Road 2 in Clarence Twp, Cornwall District. "Chlorotic" trees were evident at different locations throughout the region.
Zelleria haimbachi Bsk. Pine needle sheathminer	jP	This insect caused an average 60% foliar damage to 100% of a 15-ha plantation of 2-m trees next to Hwy 401 in Ernestown Twp, Napanee District.

An adult Sarcophaga fly (*Sarcophaga aldrichi* Parker) (left) and exposed Sarcophaga larvae removed from a parasitized forest tent caterpillar (*Malacosoma disstria* Hbn.) pupa

A forest road in midsummer in Murphy's Point Provincial Park littered with sugar maple (*Acer saccharum* Marsh.) leaves pruned by the maple petiole borer (*Caulocampus acericaulis* [MacG.])



A close view of beech (*Fagus grandifolia* Ehrh.) trees infested by beech scale (*Cryptococcus fagisuga* Lindinger). Arrow indicates small canker from which the beech bark disease (*Nectria galligena* Bresad.) was sampled. Both trees are located in Presqu'ile Provincial Park, Napanee District.

TREE DISEASES

Major Diseases

Scleroderris Canker, **Ascocalyx abietina** (Lagerb.) Schläpfer-Bernhard

Once again extensive aerial and ground surveys failed to disclose the presence of this disease in the Eastern Region during 1988.

Surveys have included a minimum of 28 ground-inspected plantations (Fig. 7) of various ages and heights. Numerous other areas were checked after aerial surveillance revealed a variety of problems that caused browning of foliage, including porcupine feeding, limestone chlorosis and root rot disease.

Surveys for both the North American and European races of this disease will continue in 1989.

Pine Needle Rust, **Coleosporium asterum** (Dietel) Sydow

Fluctuating levels of infection and defoliation of pine have been reported from Ontario each year. Severe infections can often reduce growth rates of sapling-sized trees and possibly kill smaller trees.

Detection of this fungus is easiest in late spring when it develops orange-yellow spores on pine needles. These spores later infect its alternate hosts, Aster (**Aster** spp.) and goldenrod (**Solidago** spp.), which produce orange-yellow spores in the fall that in turn reinfect the pine.

In the Eastern Region in 1988 foliar damage levels ranged from 2 to 11% on as many as 66% of the trees examined. These rather low levels of infection typify the situation in the region over the past few years. The highest incidence in 1988 was in Ramsay Township, Carleton Place District, where 66% of the 0.5-m red pine trees averaged 11% foliar damage over a 3-ha area.

Beech Bark Diseases, **Nectria coccinea** var. **faginata** Lohman, Watson and Ayers and **N. galligena** Bresad.

Large localized populations of the scale insect **Cryptococcus fagisuga** Linding. can predispose the bark tissue of beech trees to subsequent infections by the bark-cankering fungi listed above.

In 1988 the first possible association of the insect with these fungi was made at a newly discovered **C. fagisuga** infestation where the fungi were also established. **N. galligena** was sampled from the stem of a 9-m beech tree situated on the St. Lawrence River shoreline in Presqu'ile Provincial Park, Napanee District.

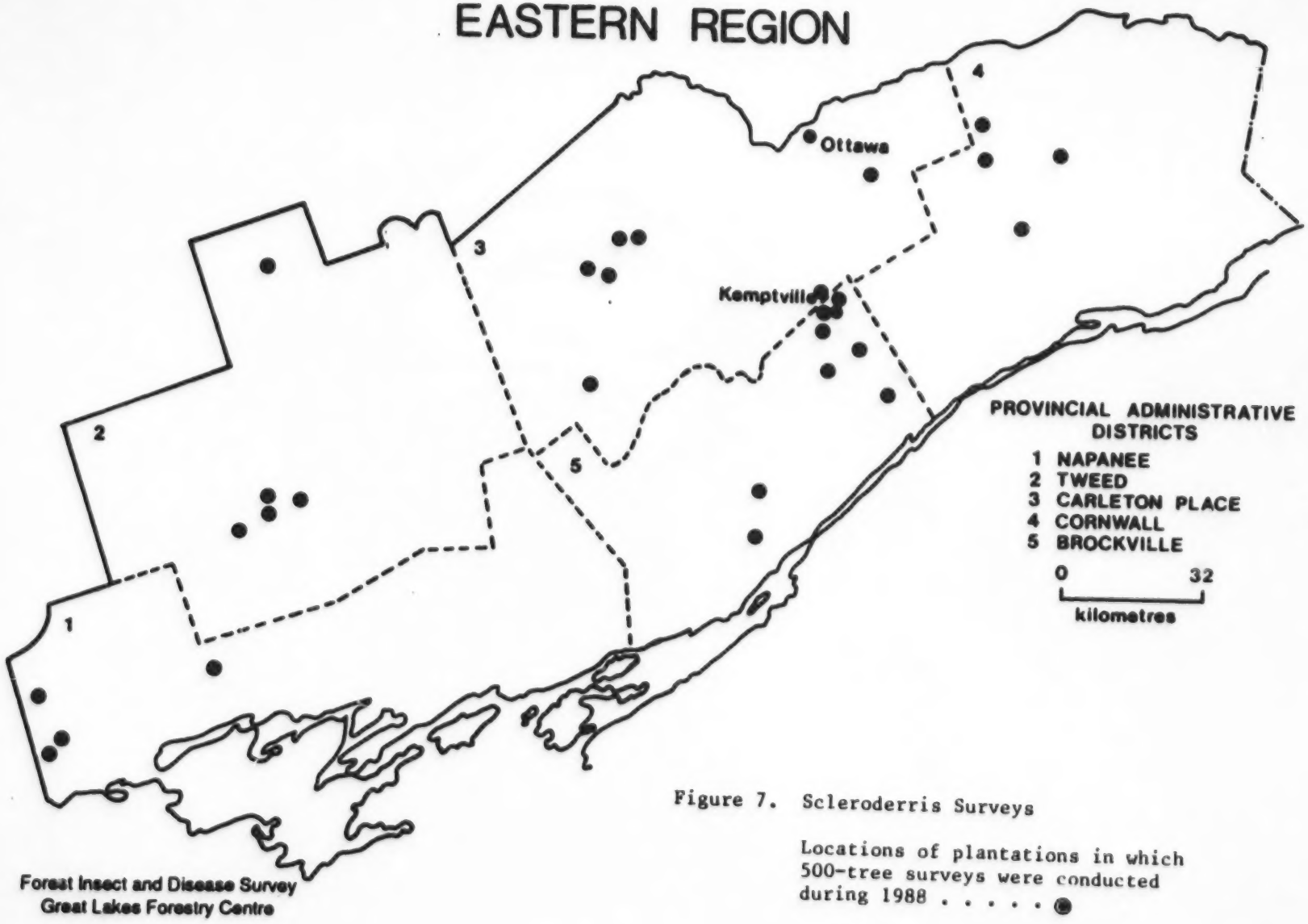


Figure 7. Scleroderris Surveys

Locations of plantations in which 500-tree surveys were conducted during 1988 . . . . . ●

Both types of fungus can cause severe cankering and possible mortality. Surveys of beech stands through the Eastern Region will continue in 1989 (see photo page).

Minor Diseases

Anthracnose Diseases of Hardwoods, **Aureobasidium apocryptum** (Ell. & Ev.) Hermanides-Nijhof, **Gnomonia** spp.

Anthracnose diseases are caused by several species of fungus that thrive in warm, wet weather. Infections begin in early spring and continue throughout the summer. Symptoms may appear as necrotic spots, or as damage resembling black frost damage over entire leaves or along their margins. The fungi then overwinter on the ground in infected leaves, buds, dead and/or living twigs.

The anthracnose **A. apocryptum** caused 100% foliar browning of white birch, sugar maple and red maple (**Acer rubrum** L.) scattered over 2 ha of roadside forest along Highway 7 in Bathurst Township, Carleton Place District.

Single bitternut hickory (**Carya cordiformis** [Wang.] K. Koch) trees sustained foliar damage ranging from 2 to 100% through the cities of Ottawa in Carleton Place District and Kingston in Napanee District.

Levels of anthracnose appeared to have been restricted in 1988, possibly because of the warm, dry weather.

Septoria leaf spot, **Mycosphaerella populicola** G.E. Thompson

This foliar disease appeared earlier in 1988 causing premature discoloration and leaf drop throughout the region. Large areas of balsam poplar (**Populus balsamifera** L.) with 60 to 100% infection levels were observed over 22 ha in Bathurst Township and 20 ha of scattered stands in Gloucester Township, both in Carleton Place District.

Table 9. Other forest diseases.

Organism	Host(s)	Remarks
Armillaria mellea (Vahl:Fr.) Kummer Armillaria root rot	jP	Evaluations revealed 2% of a 4-ha area of 20-m trees to be dying from this disease in the town of Rockland, Cornwall District.
Guignardia aesculi (Peck) Stewart Leaf blotch	horse chestnut	A single 5-m tree with 40% foliar damage was observed in Edwardsburg Twp, Brockville District.
Gymnosporangium juniperi virginianae Schwein. Cedar-apple rust	**Malus** spp. **Crataegus** spp.	widespread damage in the form of orange foliage on hosts in Tweed and Napanee districts; foliar damage averaged 60 to 100% on infected trees
Lophodermium seditiosum Minter, Staley & Millar Needle cast	rP	affected 80% of foliage on approximately 25 3-m trees in a 15-ha plantation located in South Plantagenet Twp, Cornwall District
Peltosphaeria sp. Needle cast	rP	This was associated with **L. seditiosum** at low levels (<2%) in South Plantagenet Twp, Cornwall District. This collection represents a new record of this species in Ontario.
Sphaeropsis sapinea (Fr.) Dyko & B. Sutton Tip blight	rP	Single trees with 10 to 15% branch infections were observed in the cities of Ottawa in Carleton Place District and Brockville in Brockville District. Approximately 10% of the 15-m trees in a single 25-ha plantation in Oxford on Rideau Twp, Brockville District, sustained heavy infection. About 3% of these trees were dead.

FOREST HEALTH

Maple Health Surveys

Ten semipermanent plots established during 1987 in Brockville, Carleton Place and Napanee districts were reassessed for such variables as cumulative and current branch mortality, pests, defects and growth (Fig. 8).

In 1988, cumulative branch mortality from all 10 plots increased slightly: 44% of the 250 trees had <5% dieback and 54% had 6-20% dieback (Table 10). Current branch mortality estimates disclosed that 86% of the trees contained <5% dieback.

Insect damage occurred in five plots, with forest tent caterpillar, maple trumpet skeletonizer and maple webworm being the principal defoliators. Defoliation by the forest tent caterpillar averaged <5% at Pakenham Township, Carleton Place District and Oxford on Rideau Township, Brockville District. Maple webworm was observed in Cramahe Township, Napanee District, in Nepean Township, Carleton Place District and in Rear of Yonge and Escott Township, Brockville District, where defoliation varied from <5 to 20%. Maple trumpet skeletonizer caused considerable damage at Presqu'ile Provincial Park in Brighton Township, Napanee District. Some trees here displayed as much as 20% foliar browning at the campsite plot.

North American Sugar Maple Project

In an effort to understand better the diversity of factors that affect maple health, a cooperative program was established between the United States Forest Service and Forestry Canada. The primary objective of this project is to document changes in sugar maple tree condition ratings from 1988 through 1990 in relation to various physical and environmental factors, i.e., pollution deposition, geographical relationships, whether the trees are tapped or untapped, etc. In all, 24 plots consisting of five 10-m x 10-m subplots were established at preselected sites through Ontario. Three of these were placed in the Eastern Region: in Hallowell Township, Napanee District, and in South Burgess and Rear of Yonge and Escott townships, Brockville District (Fig. 8 and Table 11). Sixty-two plots were placed across Ontario, New Brunswick, Nova Scotia and Quebec, and 103 sites were selected across seven states in the United States.

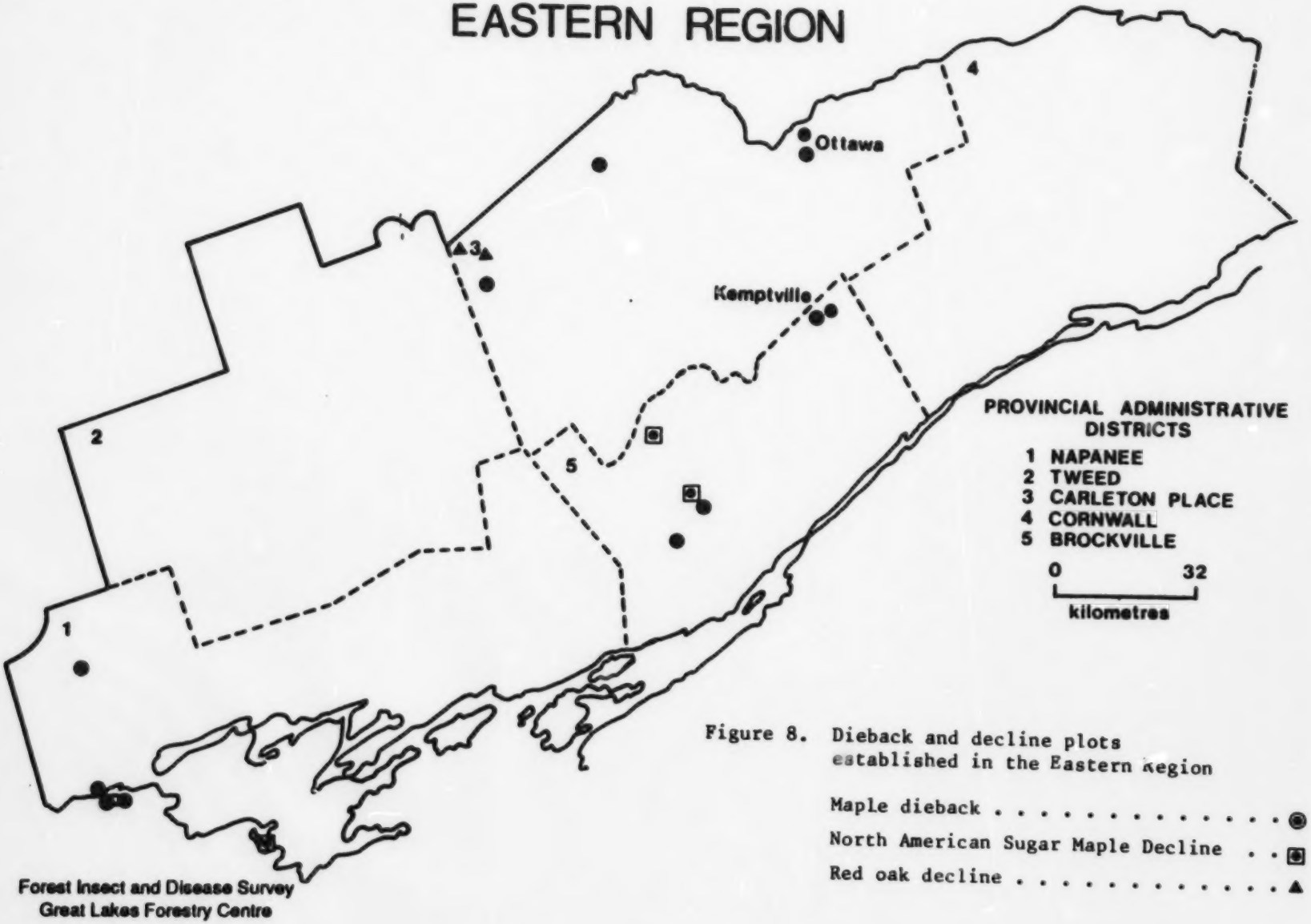


Figure 8. Dieback and decline plots established in the Eastern Region

Maple dieback . . . . . ◉

North American Sugar Maple Decline . . ▣

Red oak decline . . . . . ▲

Table 10. Summary of results from 10 plots established during 1987 to monitor sugar maple health in the Eastern Region of Ontario (data based on the examination of a minimum of 25 host trees per location).

Location (Twp)	Avg DBH (cm)	Avg ht (m)	Estimated stand area (ha)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Brockville District																
Oxford on Rideau	35.6	24	15	1987	21	4	0	0	0	0	12	13	0	0	0	0
				1988	25	0	0	0	0	0	9	16	0	0	0	0
Rear of Leeds and Lansdowne	66.4	28	2	1987	21	4	0	0	0	0	16	8	1	0	0	0
				1988	18	7	0	0	0	0	12	12	1	0	0	0
Rear of Yonge and Escott	33.6	21	30	1987	23	2	0	0	0	0	18	7	0	0	0	0
				1988	25	0	0	0	0	0	14	11	0	0	0	0
Carleton Place District																
Nepean	37.2	20	4	1987	23	2	0	0	0	0	23	2	0	0	0	0
				1988	22	3	0	0	0	1	20	4	1	0	0	1
Pakenham	50.5	25	15	1987	22	3	0	0	0	0	12	11	2	0	0	0
				1988	20	5	0	0	0	0	4	19	2	0	0	0
Lavant	37.6	22	20	1987	19	6	0	0	0	0	16	8	1	0	0	0
				1988	16	9	0	0	0	0	12	13	0	0	0	0
Napanee District																
Brighton, Staff House	40.0	20	1	1987	23	2	0	0	0	0	14	11	0	0	0	0
				1988	23	2	0	0	0	0	10	14	1	0	0	0
Brighton, Campsite	44.0	21	1	1987	24	1	0	0	0	0	20	4	1	0	0	0
				1988	21	4	0	0	0	0	3	22	0	0	0	0
Brighton, Entrance	42.0	20	2	1987	25	0	0	0	0	0	23	2	0	0	0	0
				1988	21	4	0	0	0	0	12	13	0	0	0	0
Cranahe	36.0	18	2	1987	25	0	0	0	0	0	24	1	0	0	0	0
				1988	25	0	0	0	0	0	14	11	0	0	0	0

[a] Dieback classification: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >61%

Table 11. Summary of sugar maple trees found in three North American Sugar Maple Plots established in the Eastern Region of Ontario during 1988.

Location (Twp)	Total no. of trees	No. of trees in each dieback class[a]					
		0	1	2	3	4	5
Brockville District							
South Burgess	42	31	9	2	0	0	0
Yonge and Escott	60	44	16	0	0	0	0
Napanee District							
Hallowell	30	15	15	0	0	0	0

[a] Dieback class: 0 = 5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >61%, 5 = dead trees

Red Oak Health

The two red oak (**Quercus rubra** L.) plots established in 1977 in Lavant Township, Carleton Place District (Fig. 8) were examined and rated for crown deterioration again in 1988. Since the plots were established, most crown conditions have been rated in the 0 to 20% range for current branch mortality (classes 0 and 1) at both locations (Table 12). Cumulative branch mortality is primarily in the 6 to 40% range (classes 1 and 2) for both plots (90% of all trees are in these classes in plot 1 and 80% in plot 2). Overall conditions have remained fairly constant over the past couple of years.

In 1988, average defoliation by the gypsy moth and forest tent caterpillar decreased from 18% to 10% in plot 1, while that in plot 2 remained at light levels (<5%).

ABIOTIC DAMAGE

Drought

Trees growing on shallow soils overlying Canadian Shield outcroppings and mountainous ridges experienced stress as a result of above-normal temperatures and below-normal precipitation. Premature discoloration, leaf drop, twig and branch mortality, growth loss and whole-tree mortality occurred over 20,176 ha across the region (Fig. 9).

The largest area of drought damage (18,327 ha) was in Frontenac County, Napanee District, where hardwoods, primarily, were affected. This area included Portland, Loughborough, Bedford and Storrington townships north of the city of Kingston.

Table 12. A 12-year summary of data collected from two red oak plots established in 1977 in Carleton Place District, in the Eastern Region of Ontario (based on the examination of 100 tagged trees per location).

Location	Avg DBH of trees (cm)	Stand size (ha)	Year	Current Dieback Classes[a] (% of trees) 0	1[c]	2	3	4	Trees dead	Cumulative Dieback Classes[b] (% of trees) 0	1	2	3	4	Trees dead
Carleton Place District															
Lavant Twp - Plot 1	24.0	40.0	1977	-	46	38	12	4	0	-	-	-	-	-	0
Joe Lake			1978	-	21	59	13	7	0	-	-	-	-	-	0
			1979	-	5	51	32	8	4	-	-	-	-	-	4
			1980	-	7	41	36	11	1	-	-	-	-	-	5
			1981	-	11	33	37	12	2	-	-	-	-	-	7
			1982	-	6	32	40	15	2	-	-	-	-	-	7
			1983	-	7	33	40	13	2	-	-	-	-	-	7
	26.3		1984	10	51	20	6	6	0	0	26	43	15	5	7
			1985	36	35	14	7	1	0	0	26	47	15	5	7
	26.5		1986	43	35	11	1	0	3	0	30	42	12	6	10
			1987	56	31	2	0	0	1	3	40	32	11	3	11
			1988	57	41	1	1	0	0	6	65	25	4	0	11
Lavant Twp - Plot 2															
Flower Station	19.0	15.0	1977	-	28	50	11	1	0	-	-	-	-	-	0
			1978	-	14	72	10	4	0	-	-	-	-	-	0
			1979	-	5	73	18	2	2	-	-	-	-	-	2
			1980	-	2	53	33	7	3	-	-	-	-	-	5
			1981	-	2	41	40	8	4	-	-	-	-	-	9
	20.0		1982	-	0	40	41	10	0	-	-	-	-	-	9
			1983	-	0	49	31	10	1	-	-	-	-	-	10
	21.4		1984	19	48	18	3	2	0	-	19	49	19	3	10
			1985	48	37	3	0	2	0	0	31	47	11	1	10
	21.9		1986	42	39	7	0	0	1	0	39	43	4	2	11
			1987	66	20	3	0	0	0	6	51	25	3	4	11
			1988	63	26	0	0	0	0	7	58	22	1	1	11

[a] 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >61%
[b] cumulative classification not estimated prior to 1984
[c] 1977-1983: Class 1 = 0-20% at both plots

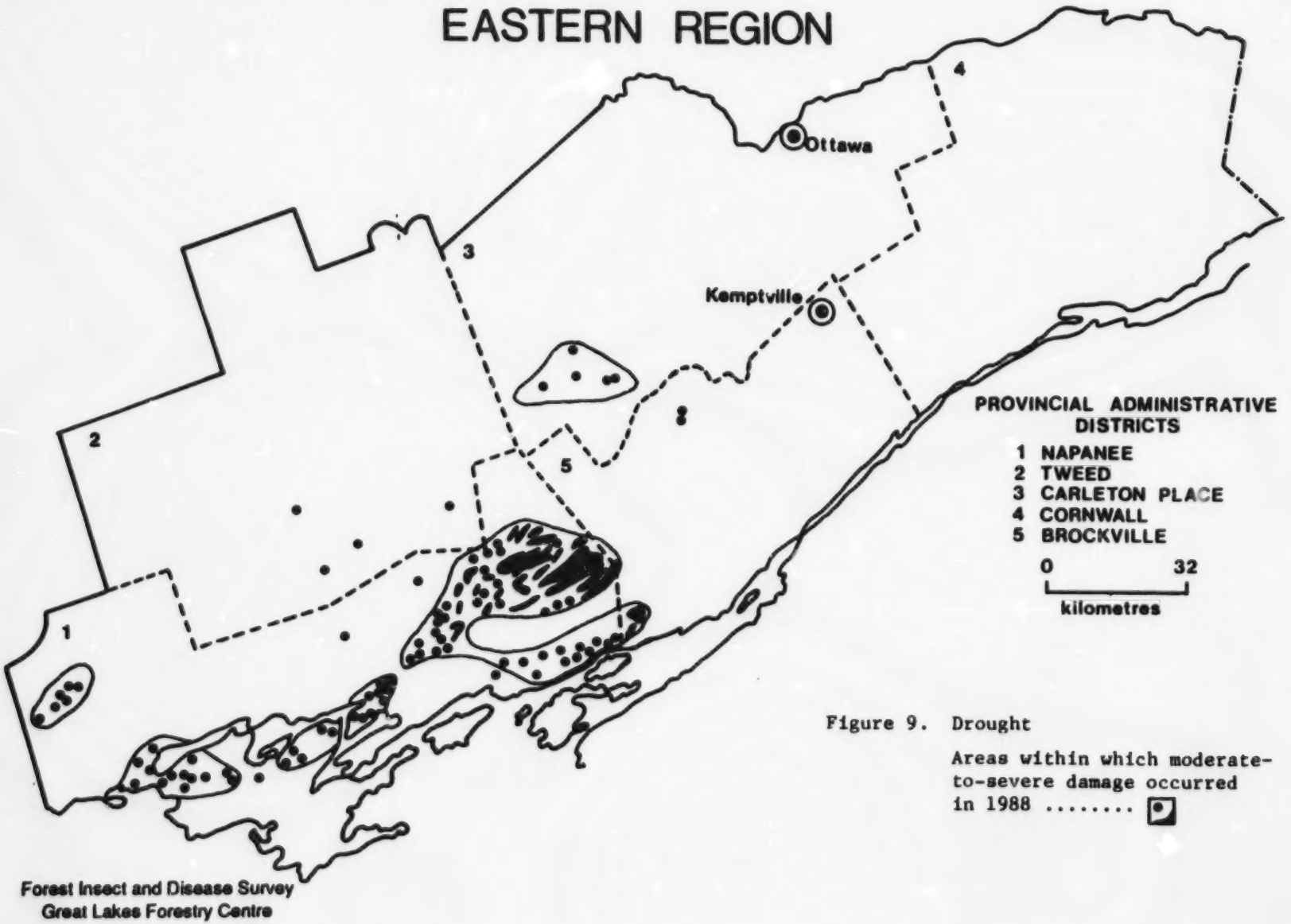


Figure 9. Drought

Areas within which moderate-to-severe damage occurred in 1988 .....

Brockville District contained 1,539 ha of damaged forest in Front of Leeds and Lansdowne Township, Leeds and Grenville County, north of the city of Gananoque.

Carleton Place District contained pockets of damage ranging from 28 ha to 69 ha scattered through Bathurst, Sherbrooke and Elmsley townships. Similar small pockets were aerially mapped in Hungerford, Elzevir and Sheffield townships, Tweed District.

It may take several years for the full effect of drought to appear. Partial death of root systems and crowns and general weakening of trees also enable secondary agents such as fungi and insects to take a greater toll over a period of two or three years.

SPECIAL SURVEYS

Red Pine Plantation Survey

Six plantations randomly selected from across the region were evaluated for damage inflicted by insects, diseases and abiotic agents (Fig. 10). Two plantations were randomly selected from each of the following height classes: 0.5-2.0 m, 2.1-6.0 m and >6.0 m. Evaluations consisted of the examination of 150 trees at each plantation during visits in the months of June and August. The stands were assessed for the presence of the following insects and diseases:

Insects: redheaded pine sawfly, pine false webworm, root collar weevil (**Hylobius** spp.) and European pine shoot moth (**Rhyacionia buoliana** [D. & S.])

Diseases: pine needle rust, Scleroderris canker, black root stain, **Verticicladiella** spp., Armillaria root rot, and needle cast (**Lophodermium** spp.)

The following is a list of the abovementioned pests not found in the current survey:

Insects: root collar weevil and European pine shoot moth

Diseases: Armillaria root rot, Scleroderris canker, black root stain and needle cast

Other pests encountered during the assessments were:

Insects: European pine needle midge (**Contarinia baeri** [Prell]) and a bagworm (**Solenobia walshella** Clem.)

The pine false webworm was the most serious defoliator encountered in all surveys performed in 1988 (Table 13). A 15-ha plantation in Ramsay Township, Carleton Place District exhibited an average of 34% defoliation over 57% of the trees. The pine needle rust was observed

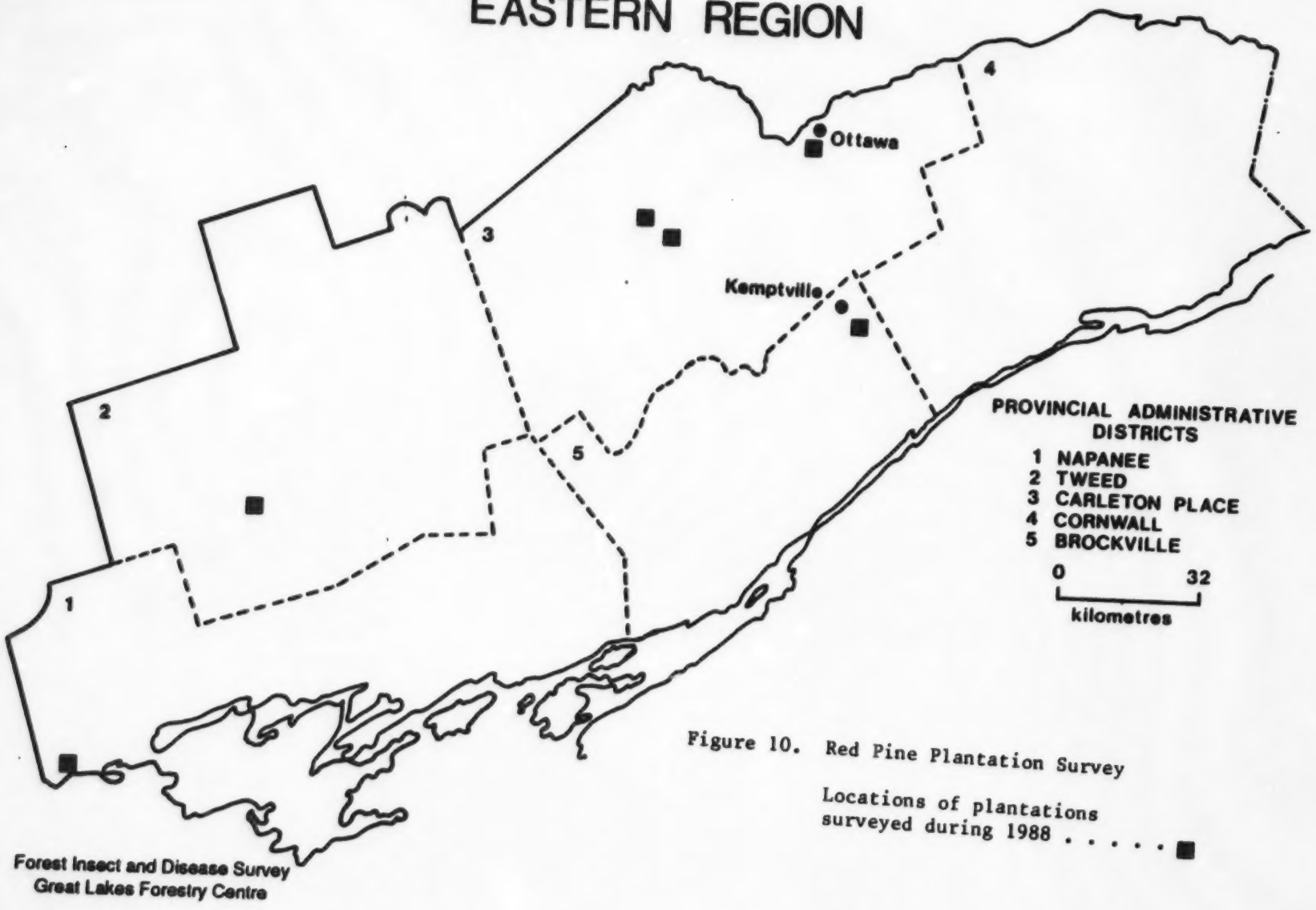


Figure 10. Red Pine Plantation Survey

Locations of plantations surveyed during 1988 . . . . . ■

Table 13. Summary of the results of red pine plantation surveys conducted at six randomly selected locations across the Eastern Region of Ontario in 1988 (counts based on the examination of 150 trees at each location).

Location (Twp)	Estimated area of stand (ha)	Estimated no. of trees per ha	Avg ht of trees (m)	Redheaded pine sawfly		Pine false webworm		European pine sawfly	
				Trees affected (%)	Avg defoliation (%)	Trees affected (%)	Avg defoliation (%)	Trees affected (%)	Avg defoliation (%)
Carleton Place District									
Gloucester	5	600	20.0	0	0	0	0	0	0
Ramsay	15	1,500	2.2	0	0	57	34	3	1
Ramsay	3	1,000	0.7	1	1	0	0	0	0
Brockville District									
Oxford on Rideau	4	1,350	1.0	0	0	2.7	1	0	0
Napanee District									
Cranahe	3	800	17.0	0	0	0	0	0	0
Tweed District									
Elzevir	7	1,200	2.5	2	1	0	0	1	0

(cont'd)

Table 13. Summary of the results of red pine plantation surveys conducted at six randomly selected locations across the Eastern Region of Ontario in 1988 (counts based on the examination of 150 trees at each location) (concl.).

Location (Twp)	Estimated area of stand (ha)	Estimated no. of trees per ha	Avg ht of trees (m)	Pine needle rust		Lophodermium spp.		Armillaria root rot
				Trees affected (%)	Avg foliar damage (%)	Trees affected (%)	Avg foliar damage (%)	Trees dead (%)
Carleton Place District								
Gloucester	5	600	20.0	0	0	0	0	0
Ramsay	15	1,500	2.2	34	4			
Ramsay	3	1,000	0.7	66	11			
Brockville District								
Oxford on Rideau	4	1,350	1.0	17	2	0	0	0
Napanee District								
Crowe	3	800	17.0	0	0	0	0	0
Tweed District								
Elzevir	7	1,200	2.5	0	0	0	0	0

in three plantations in which foliar damage ranged from 2 to 11% on 17 to 66% of the trees. The redheaded pine sawfly, European pine sawfly and a bagworm were found at trace levels in three plantations. The European pine needle midge was found in two plantations in Ramsay Township on 12 to 15% of the trees, causing light foliar damage (an average of 1%).

Red pine surveys in 1982 and 1985 revealed injury by both the pine false webworm and pine needle rust. Damage caused by the pine false webworm in both years was light (1% average foliar damage) as was that caused by pine needle rust (1 to 5% foliar damage).

Red Pine Cone and Seed Survey

Ever-increasing demands and harvesting quotas have placed an even greater emphasis on forest regeneration and seed production. This emphasis has, in the last 30 to 40 years, led to the progressive development of seed orchards that are providing a more reliable source of genetically superior seed in greater quantities. Unfortunately, these seed orchards are subject to attack by various pests and studies have shown that seed losses can be very high. Each year FIDS staff collect cone samples (100 per collection) from across the province for analysis of damaging agents. In 1988, a single collection from red pine was sampled from Gloucester Township, Carleton Place District. In this sample, 66% of the cones were damaged by insects, and there was a 69% reduction in seed as a result. Causal agents, in order of importance according to percentages of seed loss, were: 1) Lepidoptera (unidentified spp.), 2) unknown causal agents, 3) red pine cone borer, **Eucosma monitorana** Heinr., 4) a midge, **Resseliella** sp., 5) fir coneworm, **Dioryctia abietivorella** (Grt.) and 6) spruce seed moth, **Cydia strobilella** (L.).

Pinewood Nematode, **Bursaphelenchus xylophilus** (Steiner & Buhrer) Nickle

In 1987, active populations of the nematode were sampled at two locations in Nepean Township, Carleton Place District. In 1988, plots were established at both these locations, in red pine at Knoxdale Road and Cedar View, and in eastern white pine and white spruce (**Picea glauca** [Moench] Voss) off Davidson Road, in an attempt to obtain information such as rates and methods of short-range spread.

Vectors of this pest are also being determined with examinations of woodboring insects and bark beetles from the Cerambycidae, Buprestidae, Scolytidae and Siricidae families.

Samples submitted from the region during 1988 have revealed no nematode populations with the exception of a single chlorotic jack pine sampled at the Davidson Road plot, which has been confirmed to contain an active population of 'm'-form nematodes.

Acid Rain National Early Warning System (ARNEWS)

"Acid rain" has become a popular term encompassing many forms of air pollution, including wet and dry precipitation, ambient gaseous concentrations of pollutants, and airborne particulates including heavy metals, all of which can directly or indirectly, singularly or in combination, affect our forests. Consequently, in 1984, Forestry Canada set up a national monitoring program to detect and document any signs of damage to Canada's forests. FIDS staff have been given responsibility for plot establishment, monitoring and foliage and soil sampling. Three of these plots were established in the Eastern Region: in sugar maple in Rear of Yonge and Escott Township of Brockville District, in white spruce in Gloucester Township, Carleton Place District, and in eastern white pine in Hungerford Township, Tweed District. All aboveground parameters were again monitored during 1988, but no significant changes were noticed at any of the plots. Summaries of data analysis will be presented at a later date.

G. Howard Ferguson Forest Station

Compartments 33, 34 and 5 of 1-0 eastern white cedar stock sustained approximately 50% mortality (500,000 trees) from winter browning caused by moisture loss and desiccation. This winter browning was apparent on windward sides of windbreak trees situated between affected compartments, where fluctuating snow levels exposed the trees to freezing and thawing temperatures.

Rising 2 + 0 red pine stock was infected with the root rot **Cylindrocladium floridanum** Sob. & C.P. Seym. in compartments 62-64; approximately 15% mortality (150,000 trees) resulted.

The shoot blight **Ventura macularis** (Fr.) E. Müller & v. Arx was again present at trace levels (<1%) on hybrid poplar in Compartment 66.

Septoria leaf spot, **Mycosphaerella populicola** G.E. Thompson, was also evident in approximately 50% of poplar beds. Foliar damage was low (2-10%).

The cedar leafminers caused considerable foliar damage (an average of 30%) to the 15-m windbreak trees located through the nursery. Control efforts were undertaken in late May and mid-August with the insecticide Cygon at the rate of 1.14 mL per 0.46 L of water.

The Greenbelt Forest of the National Capital Commission

In compliance with requests from the National Capital Commission (NCC), assistance in monitoring general insect and disease conditions in the Greenbelt forest was again provided in 1988.

Aerial reconnaissance was initiated in the spring with C. Leger of the NCC, primarily in an effort to detect Scleroderris canker. Neither the North American nor the European race of the disease was detected; however, browning of foliage was later identified as the result of a serious infection of Swiss needle cast (**Phaeocryptopus gaeumannii** [Rohde] Petrak). Approximately 60% of 100 5-m Douglas fir (**Pseudotsuga menziesii** [Mirb] Franco) trees contained infections on 30-50% of the upper crowns in Gloucester Township near the Dolman Ridge road. Control measures (either mechanical removal or fungicidal spray) will be implemented by NCC staff.

Burlap traps and adult pheromone traps were again deployed to verify the status of gypsy moth at two locations in the Greenbelt area (Table 14). Higher numbers of trapped larvae were found, particularly at the Nepean Tent and Trailer Park, although small numbers of egg masses suggest that populations will be low in 1989.

Table 14. Results of burlap and pheromone trapping for gypsy moth at two locations in the Greenbelt Forest of the National Capital Commission during 1987 and 1988.

	Burlap Traps (10)		Pheromone Traps (2)	
	No. of larvae		No. of moths	
Location	1987	1988	1987	1988
Carleton Place District				
Nepean Twp				
Nepean Tent and Trailer Park	-[a]	718	1,101[b]	17
Gloucester Twp				
NCC Field Station	0	2	180	16

[a] data unavailable
[b] 3 traps

A small red pine plantation on Ottawa-Carleton County Road 52 near Lynwood in Nepean Township contained damage by the white pine weevil, **Pissodes strobi** (Peck). The 5-ha area contained leader damage to 28% of the 2.3-m-high trees. Control efforts by pruning will be initiated by NCC staff in 1989.

At the maple dieback plot in Nepean Township, slightly increased levels of current branch mortality (6-20%) were found on 12% of the trees in 1988, whereas only 8% sustained this level of damage in 1987 (Table 10). Increased cumulative branch mortality was evident on 52% of the trees rated, in comparison with 20% of the trees in 1987.

Climatic Data

Tables 15 and 16 contain mean monthly temperatures and total precipitation figures for two locations in the Eastern Region. These are presented for reference purposes in relation to weather-induced anomalies such as drought, which have occurred in regional forests in the past.

Table 15. A comparison of 1988 mean temperature and total precipitation with their normal values (based on a 30-year period) (figures obtained from the Ottawa International Airport).

Month	Mean temp. 1988 (°C)	Normal temp. (°C)	Deviation from normal temp. (°C)	Total precip. 1988 (mm)	Normal precip. (mm)	Deviation from normal precip. (mm)
Jan.	-9.0	-10.9	+1.9	36.8	61.0	-24.2
Feb.	-9.3	-9.5	+0.2	79.6	60.3	+19.3
Mar.	-3.3	-3.0	-0.3	27.4	67.5	-40.1
April	6.0	5.6	+0.4	91.6	69.1	+22.5
May	14.9	12.8	+2.1	32.4	67.9	-35.5
June	17.6	18.0	-0.4	94.0	73.4	+20.6
July	22.7	20.6	+2.1	78.2	85.9	-7.7
Aug.	20.3	19.2	+1.1	121.2	88.4	+32.8
Sept.	14.1	14.3	-0.2	68.0	79.3	-11.3
Oct.	5.9	8.1	-2.2	112.8	68.1	+44.7
Nov.	2.7	1.2	+1.5	82.8	77.7	+5.1
Dec.	-8.3	-7.7	-0.6	44.5	80.7	-36.2

Table 16. A comparison of 1988 mean temperatures and total precipitation with their normal values (based on a 30-year period) (figures obtained from the Trenton Air Base).

Month	Mean temp. 1988 (°C)	Normal temp. (°C)	Deviation from normal temp. (°C)	Total precip. 1988 (mm)	Normal precip. (mm)	Deviation from normal precip. (mm)
Jan.	-5.7	-7.6	+1.9	48.0	68.9	-20.9
Feb.	-7.1	-6.5	-0.6	80.4	57.0	+23.4
Mar.	-1.0	-1.0	0.0	46.3	72.0	-25.7
April	6.2	6.4	-0.2	58.4	76.1	-17.7
May	14.1	12.5	+1.6	32.7	73.0	-40.3
June	17.1	17.8	-0.7	50.4	63.7	-13.3
July	22.3	20.6	+1.7	39.0	60.9	-21.9
Aug.	21.6	19.7	+1.9	59.1	71.9	-12.8
Sept.	14.9	15.3	-0.4	44.6	72.8	-28.2
Oct.	6.7	9.2	-2.5	98.4	70.1	+28.3
Nov.	-4.3	3.2	+1.1	74.1	86.1	-12.0
Dec.	-4.5	-4.5	0.0	38.6	82.9	-44.3